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ABSTRACT

"Commercial Modular Construction Magazine" regularly contains articles where the use of modular schools and classrooms is highlighted. This document contains a selection of those articles, including: (1) "Relocatable Classrooms Come of Age" (Michael Roman); (2) "Systems Building" (Laurie Robert); (3) "Realizing Modular's Merits" (Michael Roman); (4) "Toward Cooler, Quieter, Energy-Efficient Portable Classrooms" (Pamela Reynolds); (5) "Modular Construction Delivers NJ Pre-School" (Bill Ulrey); (6) "School District Saves $200,000 with Permanent Modular Construction" (Doug Crawford); (7) "Access Analysis for Two-Story Classrooms" (Tom Shield); and (8) "Replacement Modular Buildings" (Steven Soenksen). (EV)

Modular Building Institute 2003 Educational Showcase

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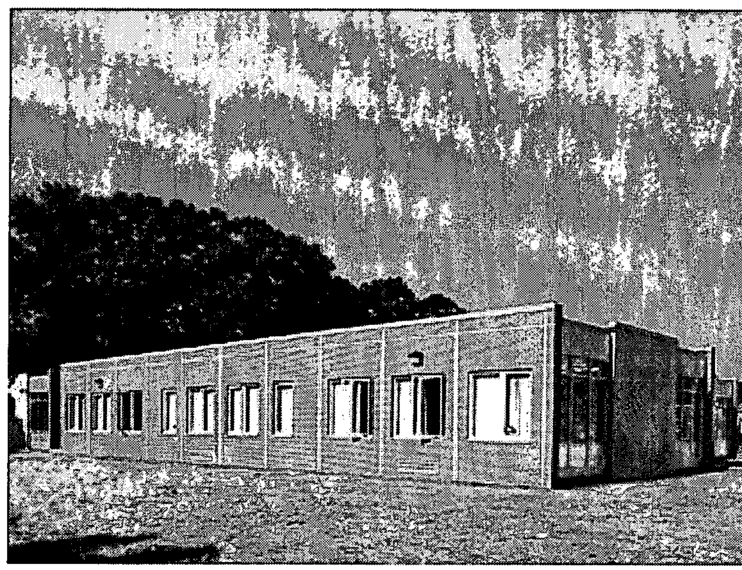
"Relocatable Classrooms Come of Age"

The President's Message
January 2003
by Michael I. Roman

The new generation relocatable classrooms have concrete floors, concrete and steel walls, heavy steel doors, larger tinted windows, and a weather proof rubber roof.



The Modular Building Institute ("MBI") estimates that more than 220,000 relocatable classrooms are currently in use by public school systems throughout the United States. California has long been the leader spurred on by legislation which withholds state funding to the local districts unless a significant portion of facility additions are capable of being moved.

The ability to relocate classrooms has long been recognized as a viable method to address shifting demographics. In addition to the relocatability feature the factory built classrooms offer speed of delivery and speed of installation. The time saving attributes work to minimize disruption while school is in session and allow for far more construction during summer recess. Site and foundation work are often done at the same time a classroom is being manufactured. It is these concurrent tasks, as well as the ability to manufacture pre-order, that generate the time savings.

For many decades, the positive product attributes have been overshadowed by the perception the classrooms were of inferior construction. In many cases, this has been true.

Public school systems have long viewed relocatable classrooms as a temporary facility solution. As such, the goal of the public school facilities department has been to get as many students as possible in classrooms for as little money as possible. With a promise (or hope) of new site built schools in the long range plan, all the facilities department had to do was bridge the enrollment gap as cheaply as possible. In budget-constrained environments, the result was easily predictable. Relocatable classrooms were ordered with the minimum of acceptable building materials. While the relocatable classrooms satisfied all building codes, the materials were not intended for long-term use. Aluminum exteriors, a metal roof, an air conditioning unit hanging off the side of the building and an elevated structure with tires often exposed added up to a trailer. These wood based buildings could be built cheaply and rented by the public school systems out of the annual operating budget. This practice saved monies in the capital budget for site built construction.

School budgets used to be largely about labor and facilities. The rapid advance of technology has upset the historic paradigm. Hardware, software and cabling now compete for precious dollars. On top of that, reduced class sizes, special education, adult education, continuing education, pre-kindergarten classes and head start initiatives all demand more space. Even without an influx of students due to shifting demographics, facilities demands are nearly overwhelming.>

A wood based relocatable classroom built with minimally acceptable building materials is capable of twenty or more years useful life given normal use and careful maintenance. Filters need to be changed monthly, care must be exercised to avoid standing water either in or under the units and repairs must be made on a timely basis. Roof leaks left unattended will rot wood floors and walls. Relocatable classrooms built of wood can deteriorate rapidly when mistreated. A deteriorating environment coupled with poor trailer-like aesthetics contributes to a less than desirable image. The negative image is further compounded when the classrooms appear in a haphazard array occupying otherwise useable recreational fields and parking lots

Many jurisdictions have been taking a hard look at their use of relocatable classrooms. As complaints rise from disgruntled parents and citizens, public schools are faced with a choice: suffer the criticism and hide behind the budget woes; abandon the use of relocatable classrooms; or upgrade the relocatable classroom specifications. The first alternative is shortsighted and often political in nature. Abandoning relocatable classrooms often times is not practical from either a space or an economic standpoint. Often, alternative space is simply not available.

Relocatable classrooms are available today that offer all the positive attributes of relocatability, speed of delivery and speed of installation yet look and operate like a site-constructed school. They can easily be relocated from school to school and have the same life expectancy as those built by a general contractor on site. These relocatable classrooms meet all building codes and are constructed of the same materials a general contractor would use. Gone are the aluminum sides; gone are the exposed air conditioning units; gone is the metal roof. Moreover, these relocatable classrooms sit on the ground and avoid the requirement of steps and skirting to hide tires. In fact, the new generation of relocatable classrooms does not even have it's own wheels and axels. They are transported to site on a flat bed trailer and lifted by crane right onto an awaiting foundation.

The new generation relocatable classrooms have a concrete floor poured in the factory, concrete and steel walls, heavy steel doors, larger tinted windows, suspended ceilings, energy efficient lighting, vastly improved air circulation and a weather proof rubber roof. In the State of Florida, the classrooms now being delivered satisfy the wind standards imposed as the result of hurricane Andrew. The wind standards reach 130 miles per hour in the Keys; fall to 120 on the coast; and 110 for the remainder of the state. Many relocatable classrooms have actually tested to 150 mile per hour standards.

Recent bids in the State of Florida demand a relocatable classroom built of either all concrete or a combination of concrete and steel. In some jurisdictions, these new relocatables are replacing wood based units that have been in service since the early 1960's. In every jurisdiction, the requested relocatables are taking the place of site built construction.

The new school construction strategy combines the ability to relocate classrooms with the permanency of what once was confined to site constructed buildings. A general contractor builds a cafeteria, gymnasium and a hall (wheel and spoke) system and relocatable classrooms are set in clusters at the end of the halls to create the school. The classrooms have a fifty year life and are non-combustible construction yet can move to other schools as the need arises.

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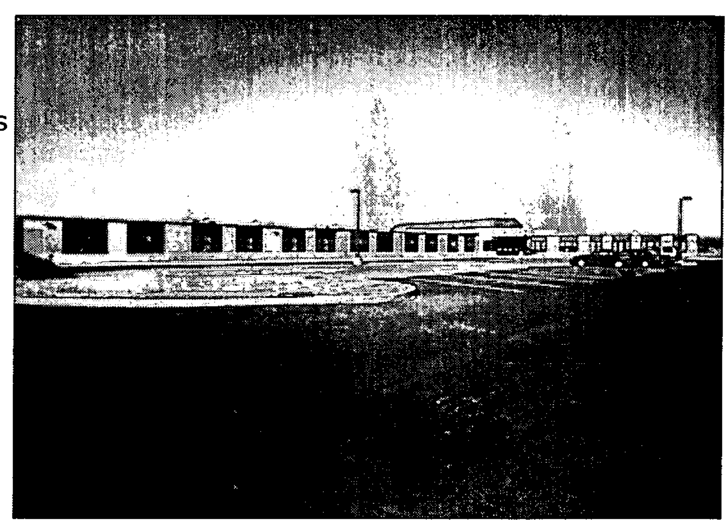
"Systems Building"

January 2003
by Laurie Robert

It's a construction concept dating back to Egypt's Great Pyramids; a practice of design and building that's found commonly today in school districts worldwide—in ordinary temporary classrooms

The fundamental principle of "systems building" has been around for thousands of years. Designing, shaping, transporting, lifting, raising, and precisely connecting components together have all been an integral part of a building concept that dates back to the Neolithic architecture of Stonehenge in England and to the Great Pyramids of Egypt. Not unlike these particular enigmas, the concept of modular construction and the untapped potential of such an exacting system still remains a mystery to many, though it is one easily explained.

Simply stated, "modular building" is a method of construction by which a building ranging from 50 to 50,000 square feet (or more), is created off-site under controlled conditions, transported to a site in three-dimensional sections, and installed on a foundation. Typically, buildings fulfilling temporary needs such as classrooms or classroom complexes are anywhere from 80 to 95% completed before they leave a manufacturer's plant. As a result, site disruption is kept to a minimum.



The roots of modular building can be traced back over a century, but advances in trends and technology over the past decade or so, have propelled it forward, making it one of the most flexible and efficient construction concepts on the market today.

Making the Right Choices

Whether you are an owner, architect, engineer, school administrator or facilities planner, you should be aware of all of the options currently available to you in factory-built construction. From the temporary classrooms outlined in this issue, to the latest in permanent schools or school additions that will be detailed in our next issue, you can be assured that modular building suppliers in this industry are a veritable wealth of information, focused on helping you achieve your objectives.

This magazine has been developed to help you, the buyer, explore the endless possibilities of modular construction, while learning what challenges, solutions, ideas and innovation have been discovered and applied throughout the U.S., Canada, and beyond.

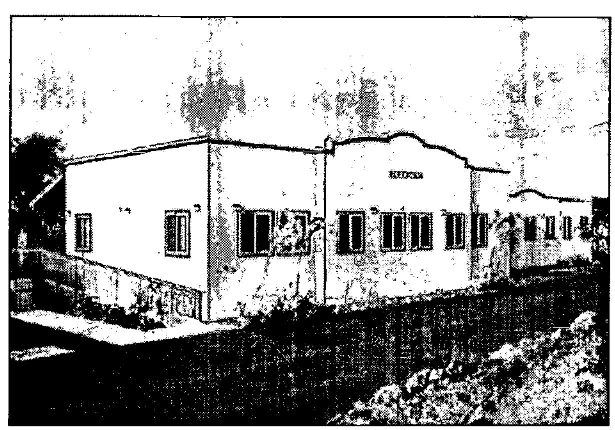
More often than not, the modular building you receive is a result of a good innovative and an educated approach. As a guide, here are five suggestions to help you maximize your opportunity to obtain a temporary classroom facility that exceeds your expectations.

1. Communicate; Research Your Options
Ask questions, meet with potential suppliers to discuss your program in depth, and if you have not already done so, research your options. Look at all the materials, features and finishes available today that are being incorporated into these classrooms to create a healthy, comfortable learning environment and consider how they might work for you.

Understand that, just like traditional construction methods, modular buildings must conform to building code standards. There is no "free license" for design criteria, no exemption from the rules. In fact, the process of modular building is subject to stringent inspection procedures by the manufacturer, and in many cases, a third party inspection agency and/or a state or local official. In most instances, builders must have a quality assurance program in place that has been approved by either the state or third-party agency, or both.

2. Set Your Expectations High!
As the buyer, planner, or specifier, you are in control. You can set the specifications, you can set the standards, and you can drive the results. So set your expectations high! There is no reason to receive "second best" in any learning environment, including relocatable classrooms. In order to ensure that your classrooms and complexes meet or exceed your expectations, communicate your needs clearly to your potential suppliers. There should be no misunderstanding.

3. Outline Your Buying Criteria
This ties in a little with communication. Modular construction offers a multitude of features and benefits. Knowing them and using them to your advantage will assist you in attaining your desired objectives.



Financing options, building features, relocatability, speed of construction, minimized site disruption, and design flexibility are just a few of the motivators that prompt school administrators and planners to look to temporary classrooms for accommodation. Letting your suppliers know what particular motivators are driving your purchase will help them prioritize, make recommendations, and respond with your specific needs in mind.

4. Establish Your Base, Then Look for More
You may have specified your classrooms right down to the fasteners, and unquestionably this is the best way of evaluating your package on an "apples to apples" basis. But consider going a step further. Ask for recommendations. You would be amazed at the breadth and depth of experience and knowledge your modular building suppliers have in house—all looking for an opportunity to apply their innovation.

5. Go For the 'Valley' Whenever You Can
Understandably there are external environmental forces at work that can prevent a school board from going out for proposals whenever they choose. Funding is usually at the top of the list. However, wherever possible, try to get a jump-start on the process so that you can be assured of securing regular production time.

Modular building companies look favorably on a steady diet of year-round production, as opposed to the peaks and valleys that tend to be more characteristic of the industry. Find out when the industry slows down in your region. It will vary between locations. Make an effort to slot your requirements into those "valley" time frames. It could be a win-win for you and your builder

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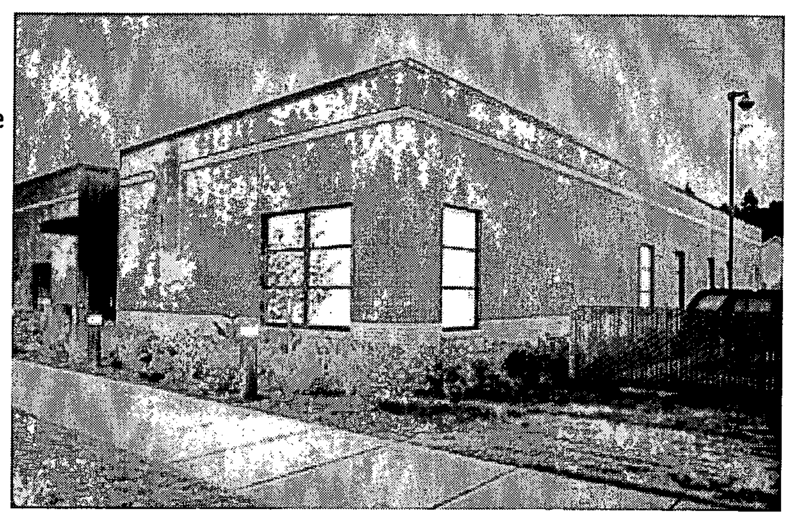
MODULAR BUILDING INSTITUTE

"Realizing Modular's Merits"

January 2003
by Michael I. Roman

A few years back the State of Florida surveyed all sixty-seven public school districts in Florida and found the average age of a temporary classroom then in use was nearly nineteen years. Not surprisingly, the State of Florida also found that both maintenance costs and operating costs rose over time. The increase in costs was not due to a rise in the price of electricity, but was the direct result of asking a wood base trailer built with a discrete useful life to do the job of a concrete and steel structure.

Recognizing the important role played by temporary trailers, the Florida legislature acted on the public school study and mandated a change in factory built classroom specifications. The Florida legislative action is a precursor to better product specifications for temporary classrooms which will be adopted state by state over the next decade. Individual states would fare far better if they followed Florida's lead earlier than later.



The peculiar product attributes of relocatability and speed of installation/deinstallation have finally been recognized as an essential planning element for forward thinking school districts. Shifting demographics, temporary needs, smaller class sizes and an ever-expanding breadth of educational alternatives all justify the use of relocatable classrooms. Even more compelling, the wave of elementary age students will eventually diminish and schools are loath to repeat the overbuilding dilemma of the sixties.

If the merits of relocatable classrooms are recognized, the best longer-term economic alternative is to procure classrooms with more substantial specifications. Relocatable classrooms are no longer required to have the look and feel of a mobile home or a construction site trailer. While it is true many relocatable classrooms have been built and continue in use with an aluminum roof, a thin trailer aluminum exterior, small windows, a residential grade door, doorframe and lockset, wood underlayment, studs and walls, and minimum lighting and ventilation, this wood based classroom is no longer the only choice.

Non-combustible classrooms are now mandated in Florida. These doublewide classrooms consist of two 12' x 40' modules built to join lengthwise to form one 24' x 40' rectangle. Built on a rigid steel frame, the classroom complies with large missile impact requirements indicating an ability to successfully withstand the hurricane force winds found in many parts of Florida. The floor is poured lightweight concrete with fiberglass reinforcement offering the feel of site built construction. Gone are the bouncing and hollow sounds often associated with the trailer classroom.

Steel studs extend from the floor to the roof and support a substantial roof structure finished with a long wear, low maintenance black rubber covering material. Similar to bicycle tire inner tubes I repaired as a kid, the rubber roof can be seamed and patched to minimize leaks. The rubber roof has a long useful life and is vastly superior in terms of both energy conservation and appearance to the aluminum found on the standard trailer classroom.

Interior walls are vinyl covered gypsum board attached to drywall. Four large windows with energy efficient glass offer substantial natural light. The exterior walls of light gauge aluminum sheets found on many classroom trailers have been replaced with a Hardi-panel fiber cement siding. This concrete material boasts a fifty-year warranty and offers a variety of finishes including a stucco appearance. Thus, instead of the look of a mobile home, the new non-combustible classroom is essentially a permanent, relocatable structure indistinguishable from its site built counterpart.

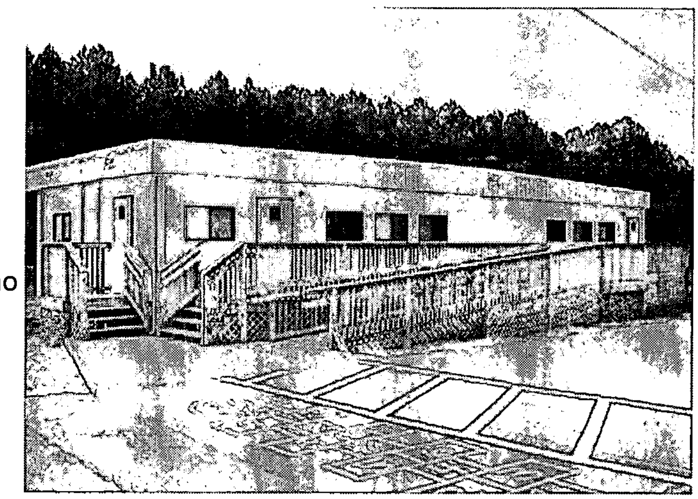
The interior floor covering of the new generation relocatable classroom sports a thick high density, high traffic carpet. Gone are the sprayed ceilings with cheap lights. The new classrooms offer T-grid 2' x 4' tiles with recessed lighting. Interior light levels have been improved with better fixtures and larger windows in response to the request for more light. The cheaper aluminum doors have been replaced with heavy metal, a steel doorframe and a commercial grade lockset. From a maintenance standpoint, the two problem areas with the older trailer classrooms have been roof leaks and faulty doors. Both have been substantially upgraded in the new non-combustible classroom.

The new classroom includes a heat pump and a superior ventilation and cooling system. Gone are the large HVAC units hanging off the back of the classroom. Air circulation has been increased and an air monitoring system has been introduced to monitor and control the learning environment.

Finally, the older trailer classrooms were pulled to the site by a truck, set on concrete blocks and aluminum skirting was added to hide the tires and axles and offer a finished appearance. Often several feet in the air, steps, decks and ramps were added at a substantial cost relative to the price of the classroom. The new non-combustible sits on the ground and eliminates the need for the costly steps, decks and ramps. This not only minimizes installation costs, but also eliminates a potential mold problem. The dank crawl space no longer exists.

The new look relocatable classrooms offer vastly superior aesthetics, significantly upgraded building components and an improved learning environment. The buildings by themselves are indistinguishable from site built schools. The remaining difference is the new relocatable classrooms do not share the same roof with the main school. Students must exit the relocatable and walk outside to reach the cafeteria, gym or restroom. This potential exposure has been addressed with a roof overhang at the front of the classroom. If two classrooms are aligned face-to-face, a ten foot covered walkway is formed. The rubber roof of each is joined to the other to form a continuous cover. A number of face-to-face classrooms set alongside each other offer a covered walk to the main school building.

The new non-combustible classroom costs more than the predecessor trailer. While everyone certainly favors a better learning environment, the real question is at what cost. This is where it can get tricky. Cost must include not only the classroom, delivery and installation, but also maintenance and operating costs over an anticipated period of use. The new classrooms are no more costly to operate and maintain than the core school–and in fact, may be far more efficient given the age of the core structure. The new generation non-combustible classrooms are far cheaper to operate due to numerous energy efficiencies. The new classrooms also require far less maintenance. The analysis boils down to the anticipated period of need.



At nearly twice the cost of the older wood based traditional trailer classroom, the new non-combustible does not make economic sense for a school system if the need is truly temporary (12 to 18 months while construction or renovation of an existing facility is underway). If the requirement is permanent, there is no question the pricier non-combustible is the way to go. It is the mid-year requirement that needs to be analyzed--and analyzed with relocatability and the cost of relocation(s) factored into the equation.

In late 1993, the Florida Center for Community Design and Research, a research arm of the University of South Florida Master of Architecture Program, released a report on The Use of Relocatable Classrooms in the Public School Districts of Florida. Prepared at the behest of the Florida Department of Education, the report provides an in-depth analysis of the use, perceptions and future of relocatable classrooms. The findings and recommendations of the report had a profound influence on the role of relocatable classrooms in Florida.

For decades, wood based classroom trailers have been used as a low cost method to provide temporary space. More often than not, the temporary requirement lasted for longer than anyone imagined. The light grade trailers were often pressed into extended service and either fell into a state of disrepair or commanded an ever-increasing share of the maintenance and operating budgets. Abuse occasioned by excessive wear and tear was manifest in damaged exteriors, well-worn interior components and poor air circulation.

The 1993 Florida study focused, in part, on the cost of relocatable classrooms as compared to permanent construction. Costs were subdivided into four distinct categories: the initial capital outlay; operating costs; maintenance costs and replacement costs. Remember that survey data for the Florida study was gathered ten years ago in 1993. Permanent school additions in 1993 in Florida cost on average about $61 per square foot. The purchase price per square foot for relocatables, delivered and installed on site, was found to average between $22 and $47 per square foot. The wide variation for relocatables must be due in part to different freight and installation costs as well as different quality in the buildings. The mid point of the 1993 relocatable price range is just over 61% of the cost of permanent school construction in 1993.

Operating costs (direct energy consumption) for a permanent common classroom in 1993 averaged $1 per square foot per year while relocatables ranged from $1 to $1.20 for low-end relocatables to $1 to $1.10 for high-end relocatables.

Maintenance costs including normal preventative and replacement maintenance were approximately $2.30 per square foot per year for permanent construction. High-end relocatables averaged $2.50 per square foot in 1993 and low-end relocatables averaged $2.75 per square foot.

Normal refurbishment and replacement costs for items such as HVAC units, roofing, exterior finishes and carpets were approximately 36% higher for relocatables than for permanent structures with total costs over a 30 year period estimated at $15,275 for a relocatable classroom and $11,167 for a permanent structure.

Life cycle cost analyses were performed on the comparative costs over a 30-year period for permanent and relocatable classrooms. Each analysis looked at estimated life expectancy, required operating and maintenance costs as well as periodic refurbishment outlays. It was assumed the relocatable stayed in place for the entire period of the analysis. Relocatables are essentially permanent structures until such time as they need to be relocated. According to the Florida study, relocatable classrooms were found to be a good investment over the 30 year anticipated life cycle if they were purchased at or below a calculated break-even price. A low end relocatable in 1993 was found to have a break-even price of $31 per square foot while a high end relocatable was found to have a break-even price of $37 per square foot. This means that in 1993, if you had a 30 year requirement for a classroom, all other things being equal, from a financial standpoint, relocatables performed the same as permanent construction if they could be purchased for $31 or less per square foot for a low end relocatable or $37 or less per square foot for a high end relocatable.

The same analysis needs to be performed for the new generation relocatable classroom. Today permanent construction averages approximately $110 - $120 per square foot. The non-combustible relocatable classroom costs about $60 - $65 per square foot plus delivery and installation. If delivery and installation are included, relocatables cost on average 60% of the cost of permanent construction. This is about the same ratio found in 1993 for the wood based relocatable, yet the new relocatable is concrete and steel.

Higher quality building components in today's relocatable means the differential in operating, maintenance and refurbishment costs found in 1993 between permanent and relocatable have been narrowed considerably. If wood based relocatables were a good investment in 1993, concrete and steel relocatables are a great investment in 2003 when compared to permanent construction.

The Florida study concluded "due to the continuation of high rates of growth in public school enrollment levels... and expected weakness in these district's fiscal position, the use of relocatable classrooms will certainly continue to expand during upcoming years. The information in this report has shown that these structures can be just as educationally effective and cost efficient in the long run as permanent classroom additions... This study has found that the primary advantages of the relocatable classroom are its ability to provide flexible, suitable short-term accommodation for

Florida's growing student population and its ability to provide that accommodation incrementally, in a timely and cost efficient fashion... The growing reliance on portable classrooms as a means to meet enrollment expansion needs is in effect shifting some portion of the financial burden for the housing of new students from the capital outlay to the operating end of the budget. This may or may not be a desirable consequence depending upon the relative ease with which the burden can be accommodated."

Florida is a leader in the use of relocatable classrooms in the US. Just as they have assured their position by mandating a new generation of relocatable classroom, it is a certainty the lessons of Florida will spread north. The new relocatables offer compelling product attributes with economics superior to permanent construction alternatives.

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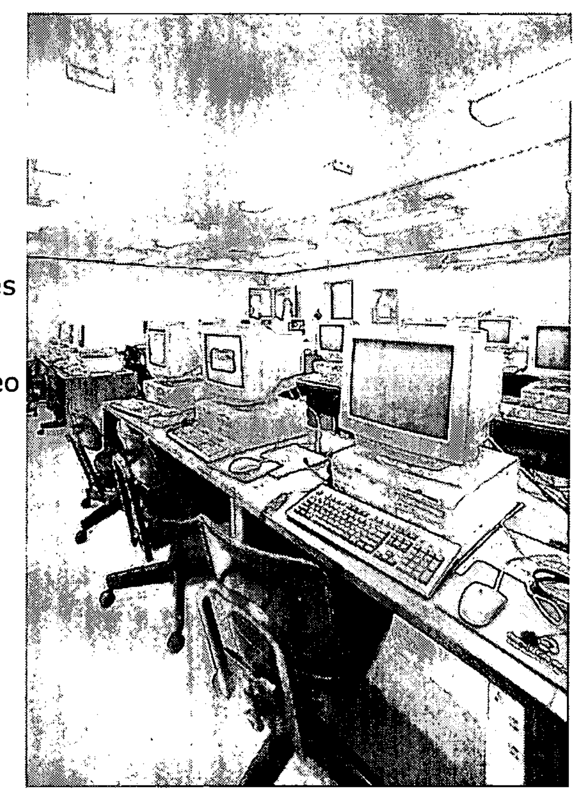
"Toward Cooler, Quieter, Energy-Efficient Portable Classrooms"

January 2003
by Pamela Reynolds

Approximately two million children in California attend school in relocatable classrooms, also known as portables. Are these buildings as environmentally healthy and energy-efficient as they can be? Berkeley Lab scientists recently tested an experimental ventilation system that would improve indoor air quality in portable classrooms and use a third of the energy of current systems.

Current HVAC systems are able to provide the 15 cubic feet per second of ventilation required in classrooms by law, but at a high energy cost, and only if the fan is turned on manually. Many portable classrooms are not being adequately ventilated, and there would be a significant impact on peak-hour energy use and the California power grid if current HVAC systems were operated continuously. A ventilation system tested by Environmental Energy Technologies Division researchers could solve those problems.

"Contrary to common belief," said Mike Apte, principal investigator, "you can design buildings that use less energy and address indoor air quality issues, if you do it right and are clever about it."



Clever ways to reduce energy consumption is one of the things EETD researchers do best. This work was done by Apte and his colleagues William Fisk, Alfred Hodgson, Richard Diamond, Dennis DiBartolomeo, Tosh Hotchi, Satish Kumar, Seung Min Lee, Shawna Liff, Leo Rainer, Marion Russell, Derek Shendell and Doug Sullivan. It was funded by the California Energy Commission. Also collaborating on the project were the Davis Energy Group, an innovator in heating and cooling technologies, two school districts, and AMS, Northern California's largest manufacturer of portable classrooms.

About one-third of all classrooms in the state are in portable buildings. This number continues to go up as California's population increases and school districts attempt to reduce class sizes. The classrooms have gained a reputation for bad indoor air quality, especially for high levels of volatile organic chemicals, or VOCs. The Berkeley Lab study set out to evaluate the benefits of an experimental building ventilation system and construction materials that emit fewer indoor pollutants.

The school districts--hot Modesto and moderate Cupertino--had each already decided to buy two new 24 foot by 40 foot classrooms. They agreed to have one standard classroom as a control, and one experimental classroom, finished with alternative low-emission carpets, wall panels and ceiling panels. Both standard and experimental buildings were constructed with energy-efficient lighting, windows, and insulation levels.

Each building also had two HVAC systems: a standard electric compressor-based air conditioner/heat pump, and an indirect-direct evaporative cooler, or IDEC. The standard heat pump is controlled by a thermostat and outdoor air is only supplied when the heat pump is either heating or cooling the air, or when the fan is turned on manually. Compared against newer heat-pump systems available on the market, many of these units have a relatively low seasonal energy efficiency ratio (SEER) rating, a measure of energy efficiency. They also have a reputation for being noisy.

The IDEC operates through the evaporation of water, but employs a heat exchanger to separate most of the water from the ventilation supply air. It provides continuous ventilation with fresh outside air, is much quieter, and uses up to 70 percent less energy than the standard HVAC. Apte and his colleagues also added a gas-hydronic heating system and an improved filtration system. The IDEC, developed by Davis Energy Group under contract from the California Energy Commission, is not currently commercially available for small buildings.

The four portables were delivered in August 2001. Air quality and comfort levels were monitored for nine weeks of hot weather in the fall and nine weeks of cold weather in the winter. The HVAC and the IDEC were operated on alternate weeks during the test periods. Researchers then compared the energy use and indoor environmental conditions for the two systems.

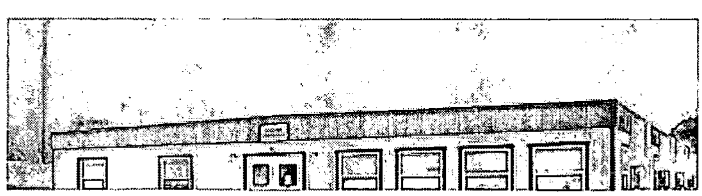
The researchers did not find that the building materials used gave off harmful levels of VOCs; the levels in both the standard and alternative-materials classrooms were very low. Apte says that although the control classrooms were furnished with standard available materials, other manufacturers could use different materials that have higher emissions.

What they did find is that continuous ventilation was a much more important factor for reducing indoor VOC levels than the alternative building materials that were selected.

Both the HVAC and the IDEC kept the classrooms heated and cooled, but the energy efficient classroom with the IDEC HVAC system required only 25 million btu/year, according to the DOE-2 computer model ?? about a third of the energy used by the currently sold standard portable with heat pump, which underventilates the classroom.

The IDEC also provided greatly improved ventilation when it was operating, during both the cooling and heating seasons, as measured by classroom carbon dioxide concentrations.

The study illustrated the added burden an inefficient ventilation system can place on teachers who, already busy with instructing, grading and maintaining order,



often forgot or neglected to turn on the HVAC. Also, they found it difficult to teach over the noise of the standard HVAC at times and preferred to suffer in a hot, cold, or stuffy room rather than compete with the sound of the fan.

"Controlling the environment comes very low on the list of things a teacher has to do," said Apte.

Late in the study the researchers installed an occupant sensor that activated the ventilation system whenever there was someone in the building. That solution could help improve air quality and take the pressure off busy educators.

There is still more number crunching and modeling to be done on the collected data, but the researchers have big plans. Next steps include outreach to help schools make choices about equipment and materials, and collaboration with a number of groups developing better classrooms. Apte also wants to study health and productivity in classrooms, and work with HVAC manufacturers to find a way to retrofit existing buildings for continuous ventilation without increased energy usage.

This project is part of a larger plan to design high-performance portable classrooms that use less energy and provide a better indoor environment than models currently available.

"I think we can contribute a lot to that with what we've learned," said Apte.

Apte and his colleagues presented their research at the Indoor Air 2002 conference in Monterey this July.

Pamela Reynolds is a former intern with Lawrence Berkeley National Laboratory in Berkeley, California where she wrote for the online magazine, *Science Beat.*

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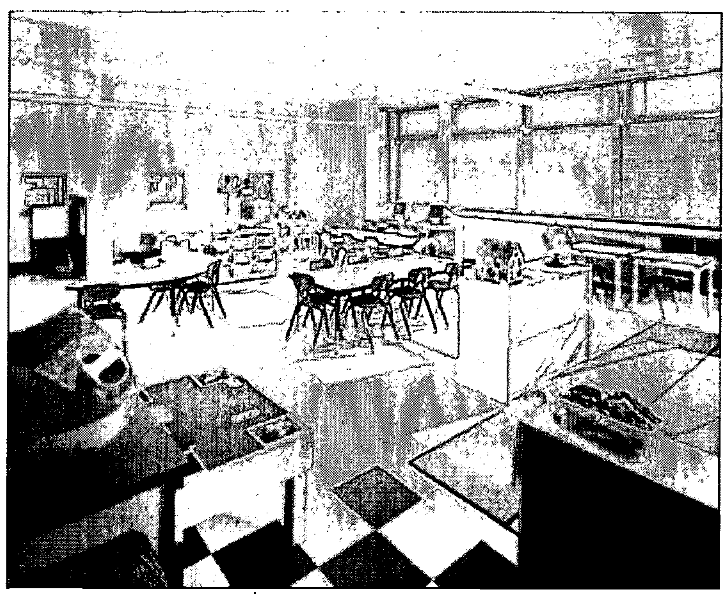
"Modular Construction Delivers NJ Pre-School"

January 2003
by Bill Ulrey

"Teachers in the new center feel they have gone to heaven."
-- Dr. Edward F. Gola, Jr., Burlington City Superintendent of Schools

In late May of 2002, New Jersey Governor James E. McGreevey broke ground on the first new facility funded through his state's historic $8.6 billion educational facilities capital improvement program. Within eight months, construction was complete using modular technology. In early January of this year, 188 pre-school students and their teachers moved into the sparkling new Early Childhood Development Center at the Samuel Smith Elementary School in Burlington City. The single-story, twelve-classroom facility embodies thoughtful design and uncompromising quality.



"Modular technology enabled us to build offsite without disrupting the ongoing educational process at the adjoining elementary school," said Robert Brehm, PE, senior vice president at Kullman Industries, Inc., manufacturer of the factory-built modules.

"We constructed the units in our plant, carried out most of the site work during summer vacation, and finished the interior in the fall," said Brehm. "The children in the elementary school were able to learn without disruption and move into a furnished new school upon returning from their holiday break--right on schedule."

"The Burlington City School District's leadership and the New Jersey School Construction Corporation (NJSCC) deserve tremendous credit for establishing the process that delivered this facility," Brehm added. "Their openness to modular construction made this remarkable story possible."

Bill Ryan, who served as the Burlington School District's business administrator during the planning process, recalls, "The Early Childhood Learning Center was an urgent priority for the community. We wanted it built as soon as possible. But we took the time to research both the modular method and specific vendors. We went to look at a five year old early-childhood center built with modular technology in Paterson. When we heard rave reviews about the quality of construction from the teachers and staff there, we knew the approach could work for us."

The building was bid as a modular facility to meet the challenges of working on the site and compressed schedule for completion. But the structure's design did not compromise on architectural complexity or quality.

"This building is as sophisticated and well-designed as any conventionally constructed school," Brehm says.

The 17,000 square foot facility was built in a factory as two wings. Representatives of the NJSCC and the Burlington City School Board were able to walk through and inspect the entire project complete with interior masonry walls, mechanical systems, and poured concrete sub-floors. Then, the structure was separated into 32 steel-frame modules and shipped to the site.

Natural light now enters the classrooms through large bay windows at a "kid friendly" height. Each room has built-in cubbyholes and matching maple cabinetry--all custom designed for the project.

"That's the most impressive thing to me. The care taken to customize the furnishings and decor is amazing," says Bill Ryan.

Sound attenuation design was used to shield students from the high decibel levels often found in our school corridors. The concrete sub-floors and acoustic ground faced block in the hallways create a quiet learning environment.

"Our educational clients don't care whether their building is constructed on- or off-site," Brehm acknowledged. "However, they demand extremely rapid construction to dovetail with their academic calendars without sacrificing any of the design attributes associated with high quality on-site construction. Modular technology gives them the best of both worlds--sophisticated, high quality buildings completed in a matter of months, not years."

The New Jersey School Construction Corporation, which oversees the State's school construction initiative, believes that modular technology has an important role to play in New Jersey's construction program.

Jerry Murphy, managing director of policy and communication for the NJSCC, says that "the NJSCC is looking at many different approaches to expedite the construction of New Jersey schools. Modular construction has shown that it can deliver quality buildings very fast."

Dr. Edward F.Gola, Jr., superintendent of schools for Burlington City, summed it up best, "Our new center is a wonderful place to teach and learn. Teachers in the new center feel they have gone to heaven."

He adds, "Teachers who work in other schools are very jealous. The Early Childhood Center is a homerun with the Board of Education, community, and staff. We welcome anyone to visit our center to see first hand what a wonderful facility it is for preschool children."

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"School District Saves $200,000 With Permanent Modular Construction"

January 2003
by Douglas Crawford

The administrators of School District 30 in Northbrook, Illinois had finally run out of space. For a dozen years, the dedicated 12-person staff, which serves more than 1,000 students, put aside their own space needs to focus on school construction efforts. Housed in an aging office trailer, administrators required more room to house employees and store key district documents and files.

"We were running out of space in the trailer and couldn't stay there forever," said Chris Young, assistant superintendent, finance & operations, Northbrook\Glenview School District 30. "Since we were planning an addition to the middle school next door, we decided the time was right to build a permanent district office."

Timing turned out to be the district's greatest challenge. Major renovations were being made on a middle school building and bus drop off area on the district's campus. The close proximity of these construction projects meant the district needed to build its new office without delaying the work being done on the school or interfering with traffic patterns. Administrators turned to the fast track techniques of modular construction to create their new headquarters. GE Capital Modular Space worked closely with the district's architect, Carole Donovan Pugh of Green Associates, to develop a single-story building that offered enough offices, work and storage space and meeting areas to accommodate staff and teachers, students, parents and other visitors.

"Going modular saved us at least $200,000 in costs compared to conventional construction," said Young. "It also allowed us to have new offices ready in a short time frame which enabled us to meet construction milestones for the work next door."

Seeing is Believing
Although the administrators were familiar with off-site fabrication, they had not seen a permanent, modularly constructed facility.

"We invited them to visit our new modular branch office building in Elgin, Illinois," said GE's Bryan Ferry. "It's an upscale complex that is highly functional and incorporates interesting architectural design."

According to Pugh, the branch office helped administrators envision the type of building they wanted for their campus.

"This was my first time being involved in using modular construction to build an administrative center," Pugh said. "Seeing the branch office solidified the fact that modular could work as a permanent facility. The client especially liked the 45-degree angled hallways of the branch office, which we were not expecting to find in a modularly constructed facility." School district officials wanted a similar facility that would fit over a basement storage level.

"Timing was critical," said Young. "We needed our new building installed quickly so that we could move the existing trailer off the site and have the necessary room for our middle school construction efforts. We broke ground on the foundation on March 9, 2001 and moved into our new offices on June 29, 2001."

Bringing the Facility Up to Speed
From the start, modular construction allowed unique techniques to save money and get the doors open quickly. Arrangements were made for the school's contractors to install a drop ceiling for electrical wiring and a sprinkler system during off-site building fabrication rather than on-site which could take up more time.

For most modular construction projects, manufacturers typically use cranes to lift modules onto the site and then roll the units into place. Northbrook administrators, on the other hand, avoided the expense of a crane with the use of a unique rolling method. To keep the project on schedule, the special roller system was designed so it could be used to carefully set the building in place while the basement floor was drying. Within 80 days, the12,000-square-foot permanent office building was ready for occupancy.

The design adopted from a modular dealer's branch office provided an ideal layout for the district's staff. Along the perimeter of the district building are a reception area, seven offices, rest rooms, kitchen/dining area and a large conference room. Flexible workstation space and a workroom are in the center. To give it the distinctive diamond shape, angled hallways were installed throughout the building instead of straight corridors. With nine-foot ceilings, the building gets plenty of natural light from its large Pella windows. The eggshell white wall coloring adds to the brightness of the hallway and offices.

Several modifications were made to better serve the day-to-day functions of Northbrook's administrators. Closet space was added to most offices, while one room was enlarged to accommodate teacher/student conference

sessions. A moveable wall enabled the conference room to accommodate gatherings and meetings of up to 60 people. Air-lock entrance doors were also installed to minimize energy costs from wind flow and reduce noise from outside. In the rear, an 800-pound elevator was installed for easy access and transport to the basement. A red brick exterior finish was selected to help the office fit in with the other buildings on campus.

"We experienced a high level of comfort throughout the entire modular building process," said Young. "This was my first major modular project and I was impressed with the expertise in construction. I think we have a very good building here."

"Going modular turned out to be a good move for the district. The building is nicely laid out and looks good," added Pugh.

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"Access Analysis for Tow-Story Classrooms"

January 2003
by Tom Shield

Schools and their districts are finding the finite amount of land available to them decreasing, due to the constant construction/installation of additional classrooms. This seemingly endless need for additional classrooms, stems from population density increasing, class size reduction becoming reality, and various other influencing factors coming into play. Hence, the introduction of the modular two-story classroom solution.

With this new concept, comes new challenges and various issues. One of which is accessibility, and most notably, accessibility to the upper story. Society appears to have accepted that accessibility to the second story is a forgone conclusion; however, there is some question as to the appropriate means to provide the accessibility. The question revolves around elevators versus wheelchair lifts. While both devices, provide accessibility, are both devices equally allowed by state and federal law? The purpose of this article is to help school districts and individuals understand responsibilities of the districts and potential liabilities.

Must all two-story classrooms be made accessible?

Yes. State regulations, Uniform Building Code, and the federal ADA all stipulate that, publicly funded buildings be accessible to individuals with disabilities. Sections 4450 and 4451 of the State Government Code states that these facilities must be accessible. The districts are of course also tied to federal law as is the state, which states that all state regulations must meet or exceed those standards as set out in federal code.

Must modular classrooms also be made accessible?

Yes. State regulations mandate that portable buildings must all be accessible. Relocatability is not an excuse to not provide accessibility in any way.

Can a vertical wheelchair lift be legally used in lieu of an elevator?
No. State and federal law stipulates that ramps and or elevators must be used to provide access, and that wheelchair lifts can only be considered in certain exceptions. There are only a few exceptions, and the only one that could be applied is if it were "technically infeasible to provide an elevator." In this case, "technically infeasible" is recognized as conditions such as having a water level within one foot of the surface or being on solid bed rock, hence making an elevator technically infeasible, due to the required pit. Some people will ask, "What about the 3,000 square foot rule?" Elevators can be exempted in buildings where the second story has 3000 square feet or less. This only applies to certain types of privately owned facilities. This does not apply, nor can it be applied, to publicly funded buildings. This is the case in both state and federal law.

Is there any instance where a wheelchair lift can be used in lieu of an elevator to access the second story of a two-story building?
Only under the exception which allows a wheelchair lift when it is technically infeasible to install an elevator. There is no language that allows the installation of wheelchair lifts in these situations. There is only language that would allow ramps or elevators.

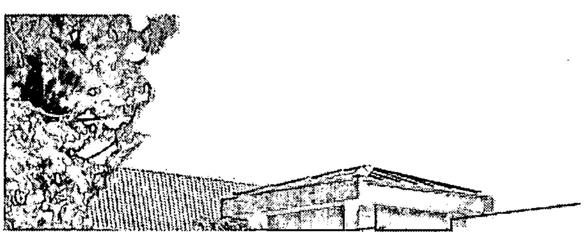
Because of the ability of modular buildings to relocate, can wheelchair lifts and elevators also be relocated?
Virtually all types of wheelchair lifts can be relocated. Typical conventionally built elevators, however, would be quite difficult to relocate, yet could be. However, new types of modular elevators are craned into place as one preassembled structure. Relocation would be done in virtually the same manner. Wheelchair lifts are no more relocatable than modular preassembled elevators.

Are there benefits to using a wheelchair lift rather than an elevator, and visa versa?
Wheelchair lifts are approximately 40% the cost of an elevator and have typically shorter manufacturing lead times; however, historically, they are not nearly as reliable, and typically require service more frequently. Wheelchair lifts can only be used for the transporting of disabled individuals, and only one at a time. Elevators can transport several individuals at a time and can be used to transport materials as needed. Depending on the number of individuals on the upper floor, one wheelchair lift may not be adequate to serve all those that need access. Elevators are also historically much, much faster than wheelchair lifts.

Must the point of access be within a certain number of feet of all classrooms?
State and federal law does not address this issue; however, there may be some civil rights implications, if there is closer access for the average non-disabled individual.

The California Division of the State Architect, Access Compliance, has come out with a policy that wheelchair lifts can be used instead of elevators under certain conditions. Can they make such policy?

The Access Compliance Division can write policy as it pertains to state Building Codes, and as specifically stated in the policy they came out with, it says "This policy will be enforced on a case by case basis; however, the Division of the State Architect will



consider the following as acceptable compliance with the California Building Code regulations. Each school district choosing to utilize two-story modular, relocatable classrooms must submit in writing to this office, a request for a waiver to use wheelchair lifts in lieu of full commercial elevators on a site by site basis. . . ." Note that the Division only references the California Building Code. They do not reference state statutory regulations or the federal ADA. The Department of the State Architect, does not have the authority to grant variances or exceptions from state statutory regulations, civil code, or the federal ADA. Most everything referenced in this package is state statutory regulations and from the ADA. It is also important to note that in the DSA's Policy statement they also state, "Two-story relocatable classrooms are considered new construction and require full-size commercial elevators for accessibility."

If a variance were granted by the Division of the State Architect, Access Compliance, are there stipulations a district should be concerned with?
They seem to use the 3,000 square foot rule, that only applies to private facilities. However, in private construction, any structure that would have less than 3,000 square feet on the second story would not have to be accessible at all. The Division of State Architect appears to be using this breaking point as a measuring stick where a wheelchair lift would be considered in lieu of an elevator. One must bear in mind however, if a two-story classroom structure with less than 3,000 square feet were constructed and a wheelchair lift were used for access, and then the structure were expanded, either the wheelchair lift would have to be removed and replaced with an elevator, or an elevator would have to be added in addition to the existing wheelchair lift. No more than one wheelchair lift can be installed in any one school facility. Hence, if you build two structures with less than 3,000 square feet in each, only one could have a wheelchair lift and the other would have to have an elevator. The district must also have a funded ADA transition plan for the school applying for the variance and must submit the plan to the state. This transition plan must be signed by the superintendent or assistant superintendent of the district applying. Only after meeting all the above would a variance be considered.

Does a variance eliminate the district's liability and exposure to litigation as result of using a wheelchair lift in lieu of an elevator?
Not at all. The district still has exposure to civil litigation under state statutory regulations, civil code, and the federal ADA. One could bring an action in either, or both, state and federal court. California is also the only state that someone can sue in state court for violations of federal law. This is only important in that California allows for treble damages and attorney fee compensation. Liability does not potentially stop with the district. The Justice Department has also looked to architects and more recently to general contractors as also having some liability for ADA violations.

Have wheelchair lifts been approved by the Department of the State Architect, Structural Division? Do any wheelchair lift manufacturers have, or do they even need, structural approval?
The Department of the State Architect has accepted and allowed low rise (two to five feet) wheelchair lifts for many years, but say that tall lifts (10 to 12 feet) must be reviewed for their structural integrity. State standards, the Uniform Building Code, and the federal ADA, all stipulate that wheelchair lifts would not be allowed in new construction, temporary, or modular/portable construction. Even though a school may be able to program around the needs of a student with a disability, they can not program around the disabled family member or friend of the student.

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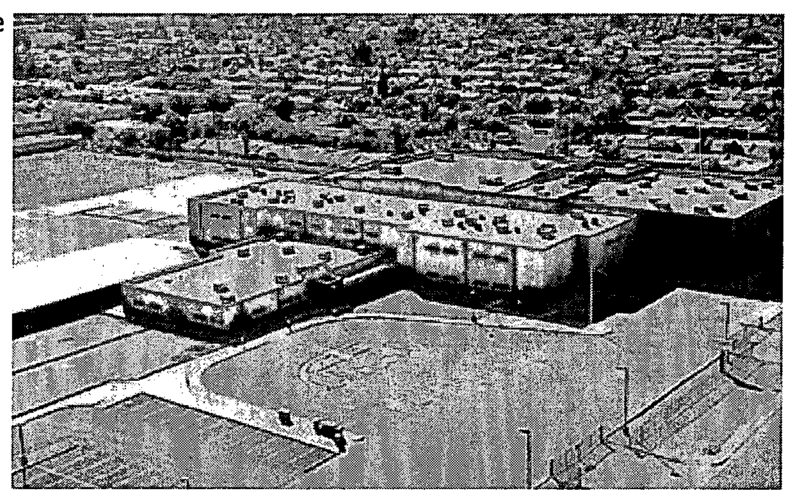
"Replacement Modular Buildings"

January 2003
by Steven Soenksen

Problem, Challenge, and Opportunity: *The term "modular buildings" covers a wide variety of building styles and configurations. As diverse as our construction industry, each project presents unique challenges and opportunities. When viewing a potential project, all must be considered.*

The Problem

The Isaac School District in Phoenix, Arizona had an existing campus with wood-framed modular classroom buildings constructed in 1996. The buildings had multiple problems, possibly related to civil engineering flaws, installation and detailing, and/or settling under the structures which caused the surrounding pavement to be higher than the wooden floor line of the building.



As rooftop water ran down the ends of the structures, it soaked sill plates and walls, and met concrete paving that sloped toward the buildings in several places, allowing surface water to saturate critical structural elements. Incidentally, building foundation vents were replaced with solid panels as student vandalism was repaired further increasing rot potential. Wood rot and accelerated deterioration was the eventual result, adding health and safety issues as a concern.

The Challenge

Isaac School District holds classes year-round, so a solution to the deteriorating classrooms had to be implemented while school was in session. Funding to complete the project was also tight.

The Solution

Modular replacement buildings with shorter construction times minimized disruption to faculty and students. A team approach was selected and the architectural firm of Orcutt-Winslow Partnership provided planning and schematic design of the new modular buildings manufactured by Modular Technology, Inc.

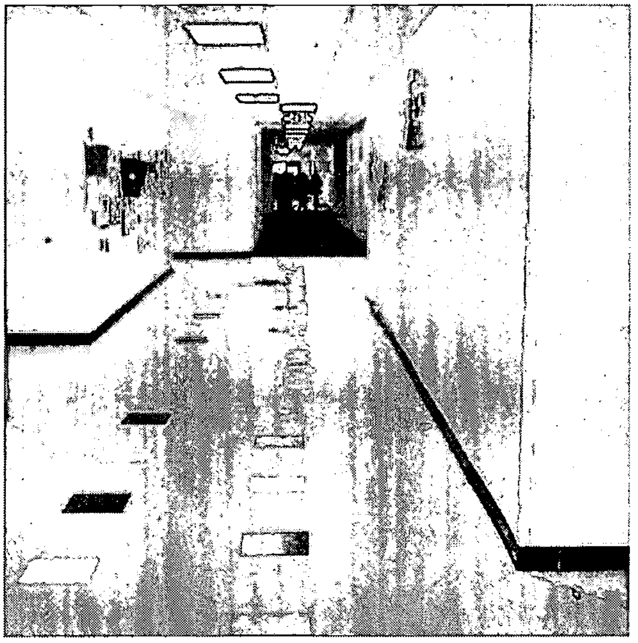
Located at Osborn and 39th Avenue on a five-acre lot surrounded by a crowded community, the building was designed as a two-story structure to provide the vitally needed classrooms for its students. Adjoining an existing 52,000 square foot two-story multi-purpose facility, the new modular addition greatly improved the architectural effects of the entire campus, and simultaneously offered greater energy-efficient amenities. Utilizing an elevator in the existing building allowed optimal design goals while meeting accessibility requirements.

Completed in just 120 calendar days, students and teachers are making good use of the modular 48,000 square foot structure that features 30 classrooms, a spacious library, two computer laboratories, and administrative area.

School districts with accelerated construction schedules are becoming more the norm today in order to meet stringent timelines and tight budgets for the facilities completion by school year commencement. Modular design expedites the construction and jurisdictional requirements in ways that are not possible through conventional construction methods. Construction schedules are further optimized by the concurrent production of the building modules at a manufacturing facility and simultaneous development of the job site. This factory-built process also reduces scheduling impacts and conflicts created by the usual convergence of construction activity.

Energy Efficiency/Opportunity

The Isaac School District project is an all- steel construction system, using fully insulated metal studs, with the insulation R-value supplemented by using an EFIS exterior application of one-inch polystyrene insulating board. It should also be noted that this EFIS system is appropriate for and offers good performance in Phoenix's hot-dry climate. The roof systems employ R-30+ batt insulation, while each classroom has individual heat pumps/coolers.



Wherever possible, the electrical designs include three phase systems to reduce electrical consumption. This includes electrically matched HVAC units utilizing scroll compressors. The energy efficiency package uses one-inch annealed tinted solar glazing on all products. This project was complete at the end of June 2002 and early indications reveal that this facility is saving Isaac School District approximately $2,000 each month in utility bills.

The real opportunity in replacement buildings can come in improving the performance in areas of health and energy efficiency. Although budgets are tight, an integrated design approach can reduce utility bills while increasing indoor air quality and comfort. In examples provided by the US Department of Energy, some new site-built schools are coming in at about the same or slightly less cost than conventional construction with up to a 40% higher energy efficiency. The cost of replacement buildings can be repaid over time where the previous facility was built to lower energy standards for performance.

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